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Electro Scientific Industries

13900 N.W. SCIENCE PARK DRIVE • PORTLAND, OREGON 97229

**BRIDGES
AND
ACCESSORIES**

DECEMBER 1966
REPLACES MAY 1964

MODELS

860A

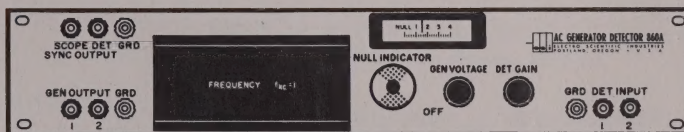
and

860B

Instruction Manual

AC

GENERATOR-DETECTOR



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DEKADIAL[®] Decade Dials
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DEKAPOT[®] Decade Potentiometers
DEKASTAT[®] Decade Rheostat
DEKAPACITOR[®] Decade Capacitor
DEKAVIDER[®] Decade Voltage Divider
KELVIN KLIPS[®] Four-terminal Clips
KELVIN KLAMPS[®] Four-terminal Clamps
PORTAMETRIC[®] Portable Measuring Instrument
PVB[®] Potentiometric Voltmeter Bridge

SECTION I

SPECIFICATIONS

GENERATOR VOLTAGE: 0 to approximately 15 volts for the Model 860A and 0 to approximately 130 volts for the Model 860B. The 860A internal resistance is approximately 600 ohms and the 860B internal resistance is approximately 40 kilohms. Generator output terminals are insulated from ground with capacitance to ground of less than 30 pf in the 860A and 50 pf in the 860B.

GENERATOR FREQUENCY: 1 kilocycle network accurate to $\pm 1\%$ supplied. 0.1, 0.4 and 10 kilocycle units available. Units between 0.05 and 10 kilocycles made to order.

DETECTOR INDICATOR: Meter plus electron ray null indicator with instantaneous response to signal changes. Dual display for strong and weak signal changes.

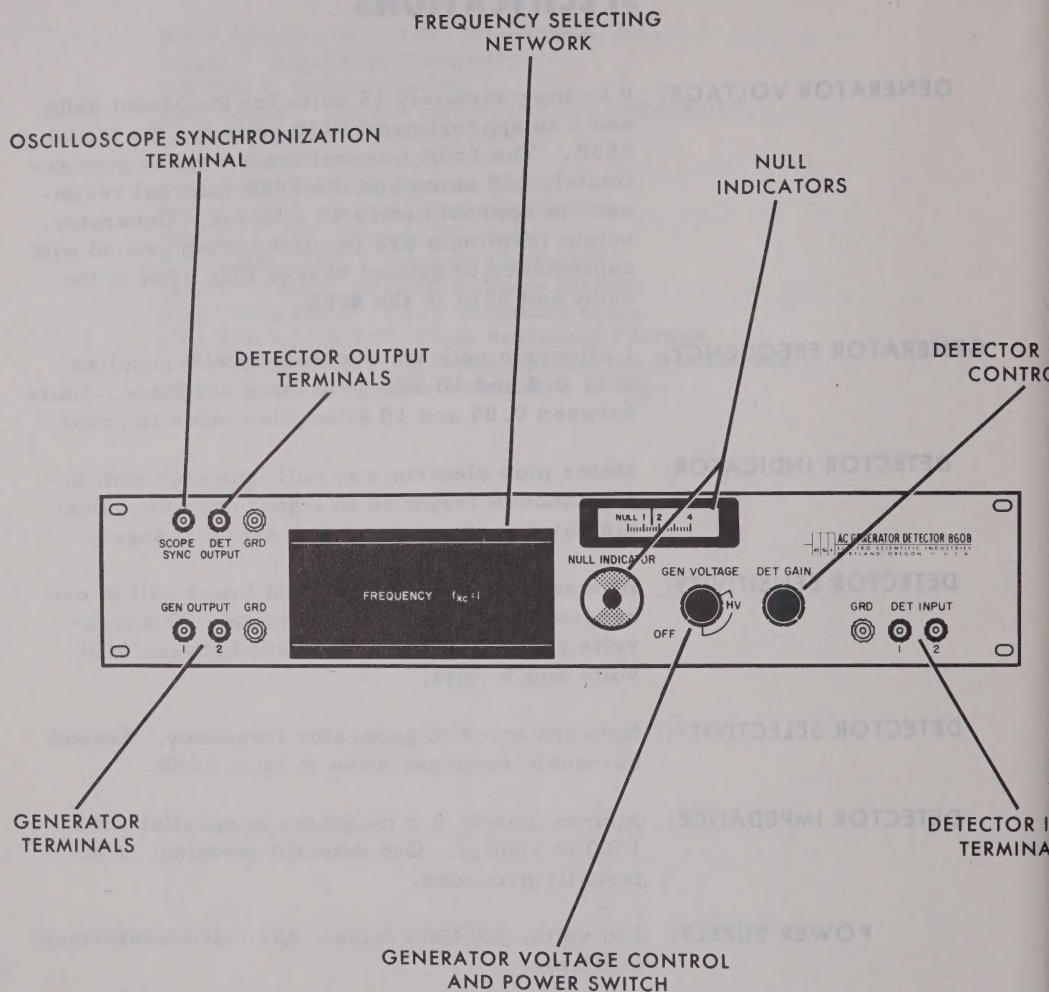
DETECTOR SENSITIVITY: At maximum gain, meter and lower half of eye respond to signals, approximately 20 microvolts to 0.01 volts. Upper eye between 0.01 volts and 5 volts.

DETECTOR SELECTIVITY: Network tuned to generator frequency. Second harmonic response down at least 30 db.

DETECTOR IMPEDANCE: Approximately 0.5 megohms in parallel with 1000 to 2000 pf. One detector terminal is internally grounded.

POWER SUPPLY: 115 volts, 50/400 cycles. 230 volt transformer available.

WEIGHT: 10 lbs net.



MODEL 860A AND MODEL 860B GENERATOR AND DETECTOR PANEL CONTROLS

SECTION II

DESCRIPTION

2.1 GENERATOR

GENERATOR VOLTAGE CONTROL: The left hand knob controls the output voltage of the generator and operates the external power switch.

FREQUENCY SELECTING NETWORK: The plug-in unit determines the operating frequency of both the generator and detector.

GENERATOR TERMINALS: The lower left hand terminals are for connecting the generator to the bridge circuit. Both generator terminals are insulated from, and have low capacitance to, ground. A ground terminal is provided for shield connections.

2.2 DETECTOR

DETECTOR GAIN CONTROL: The right hand knob varies the sensitivity of the lower half of the eye tube and the meter null indicator.

NULL INDICATORS: The dual electron ray null indicator provides an extremely broad range of sensitivity. The upper eye responds to large signals and lower eye and meter respond to very weak signals. A null is indicated by the maximum opening of both eyes and null reading on the meter.

DETECTOR INPUT TERMINALS: The lower right hand terminals are used for connecting the bridge circuit to the detector. The left hand terminal of this pair is internally grounded at the first stage of the amplifier. To minimize ground loop errors, the bridge circuit should be grounded only through this terminal. The terminal marked GRD is connected directly to the panel, and is provided for shield connections.

DETECTOR OUTPUT TERMINALS: The upper left hand terminals are for connecting an oscilloscope or other indicator to the output of the detector amplifier. They are in parallel with the lower eye and meter null indicators.

OSCILLOSCOPE SYNCHRONIZATION TERMINALS: The null signal can be presented as a Lissajous ellipse or a synchronized sine wave on an external oscilloscope.

SECTION III

OPERATION

CONNECT GENERATOR OUTPUT AND
DETECTOR INPUT TO BRIDGE

Set generator voltage control to
off for safety.

SET GENERATOR VOLTAGE CONTROL
SO THE REFERENCE MARK IS UP

This turns on the power supply,
and provides sufficient generator
voltage for most measurements.

SET DETECTOR GAIN CONTROL SO
THE REFERENCE MARK IS UP

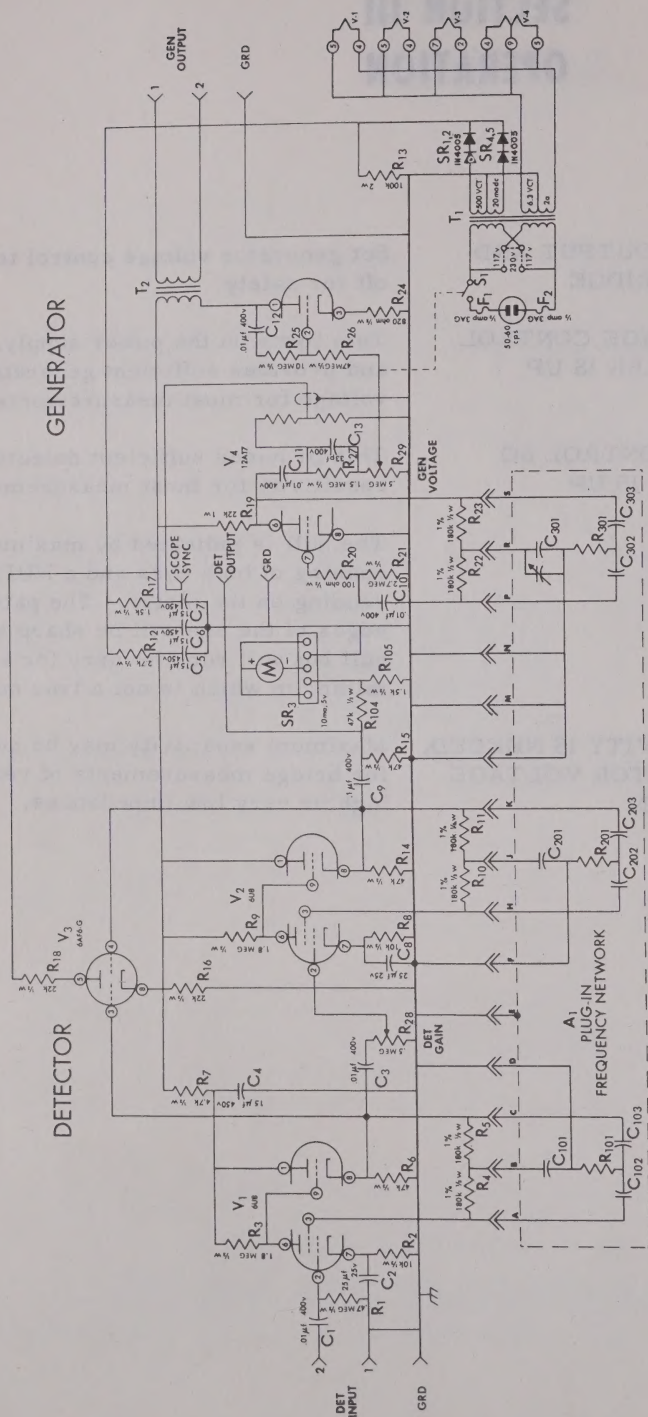
This provides sufficient detector
sensitivity for most measurements.

BALANCE BRIDGE

The null is indicated by maximum
opening of both eyes and a NULL
reading on the meter. The pattern
edges of the eye will be sharp at
null but will remain fuzzy for a
minimum which is not a true null.

IF ADDITIONAL SENSITIVITY IS NEEDED,
INCREASE THE GENERATOR VOLTAGE
AND/OR DETECTOR GAIN

Maximum sensitivity may be needed
for bridge measurements of very
high or very low impedances.



MODEL 860A AC GENERATOR-DETECTOR CIRCUIT DIAGRAM

SECTION IV

PARTS LIST AND CIRCUIT DIAGRAM

The following parts list is in alpha-numerical order of the circuit reference designator. Miscellaneous parts are included at the end of the list. Manufacturer of the part is given in a code number according to the Federal Supply Code for Manufacturers; see list of manufacturers below. Parts recommended as spares to sustain operation in isolated locations are indicated in the recommended spare parts column.

Parts manufactured by Electro Scientific Industries must be ordered from the factory. When ordering parts from the factory include the following information:

Model and serial number of the instrument
Electro Scientific Industries part number
Circuit reference designator
Description of part

CODE LIST OF MANUFACTURERS

01121	ALLEN-BRADLEY CO. Milwaukee, Wis.
04713	MOTOROLA, INC. Semiconductor Products Div. Phoenix, Ariz.
11837	ELECTRO SCIENTIFIC INDUSTRIES Portland, Ore.
19701	ELECTRA MANUFACTURING CO. Kansas City, Mo.
33173	GENERAL ELECTRIC CO. Receiving Tube Department Owensboro, Ky.
56289	SPRAGUE ELECTRIC CO. North Adams, Mass.
75915	LITTLEFUSE, INC. Des Plaines, Ill.
81095	TRIAD TRANSFORMER CORP. Venice, Calif.
84171	ARCO ELECTRONICS, INC. Great Neck, N. Y.
88141	CONANT LABORATORIES Lincoln, Nebr.

CKT REF	DESCRIPTION	MFR	ESI PART NO.	QTY USED	RECM SP
C _{1,3,10,11,12}	Capacitor, Paper, 0.01 μ f, 400v, Mfr PN 67P10304	56289	2171	5	
C _{2,8}	Capacitor, Elect., 25 μ f, 25v, Mfr PN 025809	56289	2185	2	
C _{4,5,6,7}	Capacitor, Elect., 15-15-15-15 μ f, 450v, Mfr PN 448778	56289	5273	1	
C ₉	Capacitor, Paper, 0.1 μ f, 200v, Mfr PN 191P10492S2	56289	1430	1	
C ₁₃	Capacitor, Mica, 33pf $\pm$ 5%, 400v, Mfr PN CM15E330J	84171	1944	1	
F _{1,2}	Fuse, 1/2 amp, Mfr PN 3AG	75915	1802	2	5
M ₁	Meter	11837	3140	1	
SR _{1,2,4,5}	Rectifier, Diode 1N4005	04713	1779	2	
SR ₃	Rectifier, Bridge, Selenium Mfr PN Type B	88141	1805	1	
R _{1,26}	Resistor, Fxd, Comp, 470k $\pm$ 10%, 1/2w, Mfr PN EB 4741	01121	1649	2	
R _{2,8}	Resistor, Fxd, Comp, 10k $\pm$ 10%, 1/2w, Mfr PN EB 1031	01121	1961	2	
R _{3,9}	Resistor, Fxd, Comp, 1.8 meg $\pm$ 10%, 1/2w, Mfr PN EB 1851	01121	1654	2	
R _{4,5,10,11, 22,23}	Resistor, Fxd, Deposited Carbon, 180k $\pm$ 1%, 1/2w, Mfr PN DC 1/2C	19701	1637	6	
R _{6,14}	Resistor, Fxd, Comp, 47k $\pm$ 10%, 1/2w, Mfr PN EB 4731	01121	1958	4	

CKT REF	DESCRIPTION	MFR	ESI PART NO.	QTY USED	RECM SP
R ₇	Resistor, Fxd, Comp, 4.7k±10%, 1/2w, Mfr PN EB 4721	01121	1968	1	
R ₁₂	Resistor, Fxd, Comp, 2.7k±10%, 1/2w, Mfr PN EB 2721	01121	2064	1	
R ₁₃	Resistor, Fxd, Comp, 100k±10%, 2w, Mfr PN HB 1041	01121	1626	1	
R _{16, 18}	Resistor, Fxd, Comp, 22k±10%, 1/2w, Mfr PN EB 2231	01121	2453	2	
R ₁₇	Resistor, Fxd, Comp, 1.5k±10%, 1/2w, Mfr PN EB 1521	01121	1976	2	
R ₁₉	Resistor, Fxd, Comp, 22k±10%, 1w, Mfr PN GB 2231	01121	2454	1	
R ₂₀	Resistor, Fxd, Comp, 100Ω±10%, 1/2w, Mfr PN EB 1011	01121	1977	1	
R ₂₁	Resistor, Fxd, Comp, 2.7 meg±10%, 1/2w, Mfr PN EB 2751	01121	1971	1	
R ₂₄	Resistor, Fxd, Comp, 820Ω±10%, 1/2w, Mfr PN EB 8211	01121	2058	1	
R ₂₅	Resistor, Fxd, Comp, 10 meg±10%, 1/2w, Mfr PN EB 1061	01121	1655	1	
R ₂₇	Resistor, Fxd, Comp, 1.5 meg±10%, 1/2w, Mfr PN EB 1551	01121	1653	1	
R ₂₈	Resistor, Var, 0.5 meg, Mfr PN J 66044	01121	3512	1	
R ₂₉	Resistor, Var, 0.5 meg, Mfr PN JS 66045	01121	3513	1	

CKT REF	DESCRIPTION	MFR	ESI PART NO.	QTY USED	RECM SP
S ₁	Switch, Part of R ₂₉				
T ₁	Transformer, Power, Mfr PN 8504	81095	2514	1	
T ₂	Transformer, Output, Mfr PN 2996 (860A) Mfr PN 46101 (860B)	81095	2675	1	
		81095	7847	1	
V _{1,2}	Tube, Electron, 6U8A	33173	5275	2	
V ₃	Tube, Electron, 6AF6G	33173	5274	1	
V ₄	Tube, Electron, 12AT7	33173	5276	1	
	<u>MISCELLANEOUS</u>				
	Knob	11837	1268	2	
	Cap, Binding Post, Ins	11837	1170	6	3
	Cap, Binding Post, Metal	11837	1172	3	2
	Binding Post	11837	1393	9	
	Shield, Eye Tube	11837	2755	1	
	Insulator, Binding Post	11837	8823	6	



Electro Scientific Industries, Inc.

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THE ESI WORKING STANDARDS AND TESTING APPARATUS USED ARE CALIBRATED AGAINST THE REFERENCE STANDARDS IN A RIGOROUSLY MAINTAINED PROGRAM OF MEASUREMENT CONTROL.

THE MANUFACTURE AND FINAL CALIBRATION OF THIS INSTRUMENT WERE CONTROLLED BY THE USE OF THE ESI REFERENCE AND WORKING STANDARDS AND TESTING APPARATUS IN ACCORDANCE WITH ESTABLISHED PROCEDURES AND WITH DOCUMENTED RESULTS. (REFERENCE MIL-C-45662)



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BATTERIES AND TUBES WHICH HAVE GIVEN NORMAL
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(Please Print)

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Department _____ Mail Stop _____

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- EB23** A New Approach to Bridge Sensitivity, *Jack Riley, November 1962*
- EB24** Calibration of a Kelvin Varley Voltage Divider, *Merle L. Morgan and Jack Riley, August 1960*
- EB26** International System of Units, *August 1964*
- EB29** DC and Low Frequency AC Ratio Measurements, *Dr. Merle L. Morgan, September 1962*
- EB31** Transformer Bridge Theory and Practice, *Jack C. Riley, January 1964*
- EB35** An Improved Technique for Establishing Resistance Ratios, *R. M. Pailthorp and J. C. Riley, November 1962*
- EB41** Derivation of Electrical Units from Fundamental Standards, *R. D. Kuykendall and R. M. Pailthorp, July 1964*
- EB43** Metrology Seminar WESCON 1964, *September 1964*
- EB44** DC Measurements Using Ratio Techniques, *Jack C. Riley, September 1965*
- TA2** A Ratio Transformer Bridge for Standardization of Inductors and Capacitors, *D. L. Hillhouse and H. W. Kline, August 1960*
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- TA11** An International Comparison of Inductive Voltage Divider Calibrations at 400 and 1000 Hz, *W. C. Sze, A. F. Dunn, and T. L. Zapf, January 1967*
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- TA13** A 1-100 Ω Build-Up Resistor for the Calibration of Standard Resistors, *B. V. Hamon, January 1967*
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